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(71) Applicant:
NIPPON CONLUX CO., LTD.
Chiyoda-ku Tokyo-To (JP)

(72) Inventors:
- **Onodera, Akira**
  Kawagoe-Shi, Saitama-Ken (JP)
- **Yamazaki, Koichi**
  Sakado-Shi, Saitama-Ken (JP)

(74) Representative:
Reichel, Wolfgang, Dipl.-Ing. et al
Reichel und Reichel
Parkstrasse 13
60322 Frankfurt (DE)

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(54) Jump controller for an optical information recording and reproducing apparatus

(57) A jump controller in an information recording and reproducing apparatus for an optical information recording medium (107) having guide tracks for the information recording and reproducing by applying a light beam while making an optical head traverse a number of guide tracks and reach a target guide track, comprises a track traverse detector (103) forming a track traverse detecting signal from a tracking error signal from a photodetector (101) in the optical head; a current generator responsive to a track jump command for moving the optical head from a present track to another track and supplying a drive current to a driver for an objective lens (106) of the optical head, and supplying a damping current by reversing the polarity of the drive current when the track traverse detecting signal is supplied; and a converter (R104, R105, C100) converting the drive current and the damping current into a rapidly rising and gradually falling current. This controller allows the optical head to rapidly jump to a nearby track.

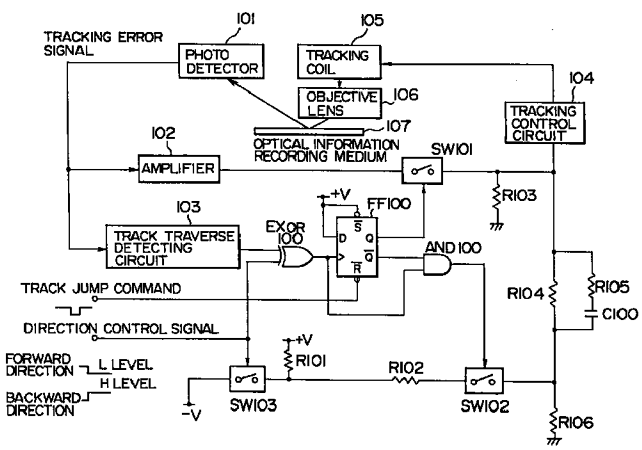

FIG. 1

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Description

The present invention relates to a jump controller for an optical information recording and reproducing appratus for an optical information recording medium wherein information is recorded by forming a pit upon application of a light beam to the recording medium while aligning an optical head to a track position, and information is read form a pit by using the light beam.

For the optical head in a conventional information recording and reproducing apparatus, a means is provided for generating a tracking error signal whose polarity changes between a positive polarity and negative polarity in response to a track traverse by the optical head. A track traverse detecting signal is generated by comparing the tracking error signal with a reference signal. In case of a jump to nearby tracks the optical head is gradually accelerated and decelerated.

It is the object of the present invention to provide a jump controller allowing the optical head in an apparatus of the above kind to perform a near jump to a nearby track speedily.

In order to achieve this object, the present invention provides a jump controller for an information recording and reproducing apparatus for an optical information recording medium having a plurality of guide tracks for the information recording and reproducing, for recording and reproducing information to and from the medium by applying a light beam while making an optical head traverse a predetemined number of guide tracks and reach a target guide track, comprising:

a track traverse detecting circuit for forming a track traverse detecting signal from a tracking error signal supplied from a photodetector assembled with the optical head;
a current output circuit responsive to a track jump command for moving the optical head from a present track to another track, for supplying a drive current to an objective lens driver for an objective lens assembled with the optical head, and supplying a damping current by reversing the polarity of the drive current to the objective lens driver when the track traverse detecting signal is supplied; and
a conversion circuit for converting the drive current and the damping current outputted from the current output circuit into a rapidly rising and gradually falling current.

A guide track is formed on the recording surface of an optical information recording medium. Information is recorded and reproduced by making a light beam traverse guide tracks and reach a target track. In moving the light beam to the target track, the current output circuit responds to a track jump command, and supplies a drive current to the objective lens driver. The driver current is transformed by the conversion circuit into a rapidly rising and gradually falling current, and supplied to the driver. The objective lens then moves. When the light beam reaches a track adjacent the target track, the track traverse detecting circuit supplies a track traverse detecting signal. In response to this signal, the current output circuit supplies a damping current by reversing the polarity of the drive current to the driver. The damping current is transformed by the conversion circuit into a rapidly rising and gradually falling current, and supplied to the driver.

According to the present invention, a rapidly rising and gradually falling drive current is supplied to the objective lens driver to move the light beam, and when the light beam reaches an adjacent track, the polarity of the drive current is reversed, and a rapidly rising and gradually falling damping current is supplied. Accordingly, the objective lens driver can be accelerated rapidly and decelerated gradually. As compared with a conventional gradual acceleration and deceleration, jumping to nearby tracks can be completed in a very short time duration.

In the accompanying drawings:

Fig. 1 is a block diagram showing the circuit arrangement of an embodiment of the present invention;

Fig. 2 is a detailed circuit diagram of the track traverse detector shown in Fig. 1;

Fig. 3(a) and 3(b) is timing charts showing the signal waveforms at various circuit portions shown in Fig. 1.

Fig. 1 is a circuit diagram showing the structure of an embodiment of a near jump controller for controlling an optical head to jump to a nearby track according to the resent invention. Fig. 2 is a detailed circuit diagram showing the structure of the track traverse detector in the circuit shown in Fig. 2. Fig. 3a and 3b are timing charts showing signal waveforms at various circuit portions shown in Fig. 1.

Referring to Fig. 1, reference numeral 107 represents an optical information recording medium. A light beam radiated through an objective lens 106 is focussed on the optical card 107, and the reflected light is applied to an optical detector 101 to form a tracking error signal. This tracking error signal is amplified by an amplifier 102 and supplied via a switch SW101 to a tracking controller 104 to drive a tracking coil 105 for driving the objective lens 106.

The tracking error signal is also supplied to a track traverse detector 103 the details of which will be later described with Fig. 2. The track traverse detector 103 shapes the tracking error signal into a rectangular waveform to generate a track traverse detecting signal.

This track traverse detecting signal is supplied to one input terminal of an exclusive OR EXOR100. Supplied to the other input terminal of EXOR100 is a direction control signal which takes an L level when the objective lens is moved in the forward direction and an

H level when it is moved in the backward direction. The direction control signal is also used for opening and closing a switch SW103. For the forward direction, the switch SW103 opens to supply the positive power source voltage +V to the left contact of the switch SW102 as viewed in Fig. 1 via resistors R101 and R102. For the backward direction, the switch SW103 closes to supply the negative power source voltage -V to the left contact of the switch SW102 via the resistor R102.

A signal at the Q output terminal of a flip-flop FF100 is used for opening and closing the switch SW101. This signal of an H level closes the switch SW101 to always maintain the light beam at the center of a track, and the signal of an L level opens the switch SW101. A signal at an inverted $\overline{Q}$ output terminal of the flip-flop FF100 as well as an output from EXOR100 is supplied to an AND gate AND100 whose output is used for opening and closing the switch SW102.

While the switch SW101 opens and the switch SW102 closes, a voltage corresponding to the state of the switch SW103 is supplied to the tracking controller 104 via a conversion circuit made of a parallel circuit of a resistor R104 and a serially connected resistor R105 and capacitor C100. The tracking controller 104 flows a current to the tracking coil 105 to start moving the objective lens 106. When the switch SW102 opens under this condition, the tracking controller 104 receives a voltage signal of an inverted polarity and flows a damping current to the tracking coil 105.

Fig. 2 shows the detailed structure of the track traverse detector 103 shown in Fig. 1. The tracking error signal applied to an input terminal IN100 is supplied to the inverting terminal of a comparator CMP100 via an integrator made of a resistor R111 and capacitor C111. A reference signal Vref is applied to the non-inverting input terminal of the comparator CMP100. The tracking error signal is compared with the reference signal, and the comparison result is outputted via a resistor R116 to an output terminal OUT100. This reference voltage Vref is a voltage divided by a serial circuit made of resistors R115, R113, and R112.

The resistor R113 is a feedback element connected between the non-inverting input terminal and output terminal of the comparator CMP100. The reference voltage Vref changes with an output voltage of the comparator CMP100. As the feedback element of the comparator CMP100, a serial circuit of a resistor R114 and capacitor C112 is also connected to add an offset to an output of the comparator CMP100.

Fig. 3(a) und (b) show signal waveforms at various circuit portions of Fig. 1 during the forward jump and backward jump operations. The operation of the circuit of Fig. 1 will be described with reference to these waveforms shown in Fig. 3(a) and (b).

<u>Forward Direction Jump</u>

In order to determine the motion direction, the direction control signal is set to an L level for the forward direction jump. With the L level signal, the switch SW103 opens, and so the positive voltage is applied via the resistors R101 and R102 to the left contact of the switch SW102. A track jump command of an L level is issued at time t_{11} and supplied to an inverted reset terminal $\overline{R}$ of the flip-flop FF100. Therefore, the Q output of the flip-flop FF100 takes an L level to open the switch SW101 and stop the control of making the light beam follow the center of a track. The inverted $\overline{Q}$ output of the flip-flop FF100 takes an H level to close the switch SW102 and supply a positive voltage to the converter circuit made of the resistors R104, R105 and capacitor C100. Accordingly, a drive current shown in Fig. 3(a) flows in the tracking coil 105 to start moving the objective lens 106 in the forward direction.

As the objective lens 106 moves, the tracking error signal changes from a zero level to a negative level and from the zero level to a positive level. When the tracking error signal becomes larger than the reference value Vref, the track traverse detecting signal takes an L level. Therefore, both the inputs to EXOR100 are L level, and the output is L level. With an L level of the output of EXOR100, the input conditions of the AND gate AND100 are negated. Therefore, the AND gate AND100 supplies an L level signal to the switch SW102 to open it.

Accordingly, the positive voltage having been applied to the conversion circuit disappears at once so that a current in the opposite direction will flow through the tracking coil 105 to provide a fast damping. This damping is carried out at time t_{12} shown in Fig. 3(a). At time t_{13} when the tracking error signal again takes the zero level (when the light beam reaches the center of the track), the track traverse detecting signal takes an H level. With H and L level inputs, EXOR100 outputs an H level signal. The rising edge of this H level signal is applied to a clock terminal of the flip-flop FF100 so that the Q output of the flip-flop FF100 takes an H level to close the switch SW101 and lock the objective lens 106 at that position. The inverted $\overline{Q}$ output of the flip-flop FF100 takes an L level, and so the input conditions of the AND gate AND100 are negated to supply an L level signal to the switch SW102.

<u>Backward Direction Jump</u>

In order to determine the motion direction, the direction control signal is set to an H level for the backward direction jump. Therefore, the switch SW103 closes, and so the negative voltage -V is applied via the resistor R102 to the left contact of the switch SW102. When the switch SW102 closes, the direction of the current flowing through the tracking coil 105 becomes opposite to that during the forward direction jump. As shown in Fig. 3(b), the tracking error signal changes in the opposite direction to that shown in Fig. 3(a). The operation is similar to that during the forward direction jump except that the input conditions to EXOR100 are reversed.

Claims

1. Jump controller in an information recording and reproducing apparatus for an optical information recording medium (107) having a plurality of guide tracks for the information recording and reproducing, for recording and reproducing information to and from the medium (107) by applying a light beam while making an optical head traverse a predetermined number of guide tracks and reach a target guide track, comprising:

   a track traverse detecting circuit (103) for forming a track traverse detecting signal from a tracking error signal supplied from a photodetector (101) assembled with said optical head;
   a current output circuit responsive to a track jump command for moving said optical head from a present track to another track, for supplying a drive current to an objective lens driver for an objective lens (106) assembled with said optical head, and supplying a damping current by reversing the polarity of said drive current to said objective lens driver when said track traverse detecting signal is supplied; and
   a conversion circuit (R104, R105, C100) for converting said drive current and said damping current outputted from said current output circuit into a rapidly rising and gradually falling current.

2. Jump controller according to claim 1, wherein said conversion circuit (R104, R105, C100) is a parallel circuit of an element (R104) transmitting a voltage without a transient change and a differentiating element (R105, C100).

3. Jump controller according to claim 2, wherein said element (R104) transmitting a voltage without a transient change is a resistor, and said differentiating element (R105, C100) is a serial circuit of a resistor (R105) and a capacitor (C100).

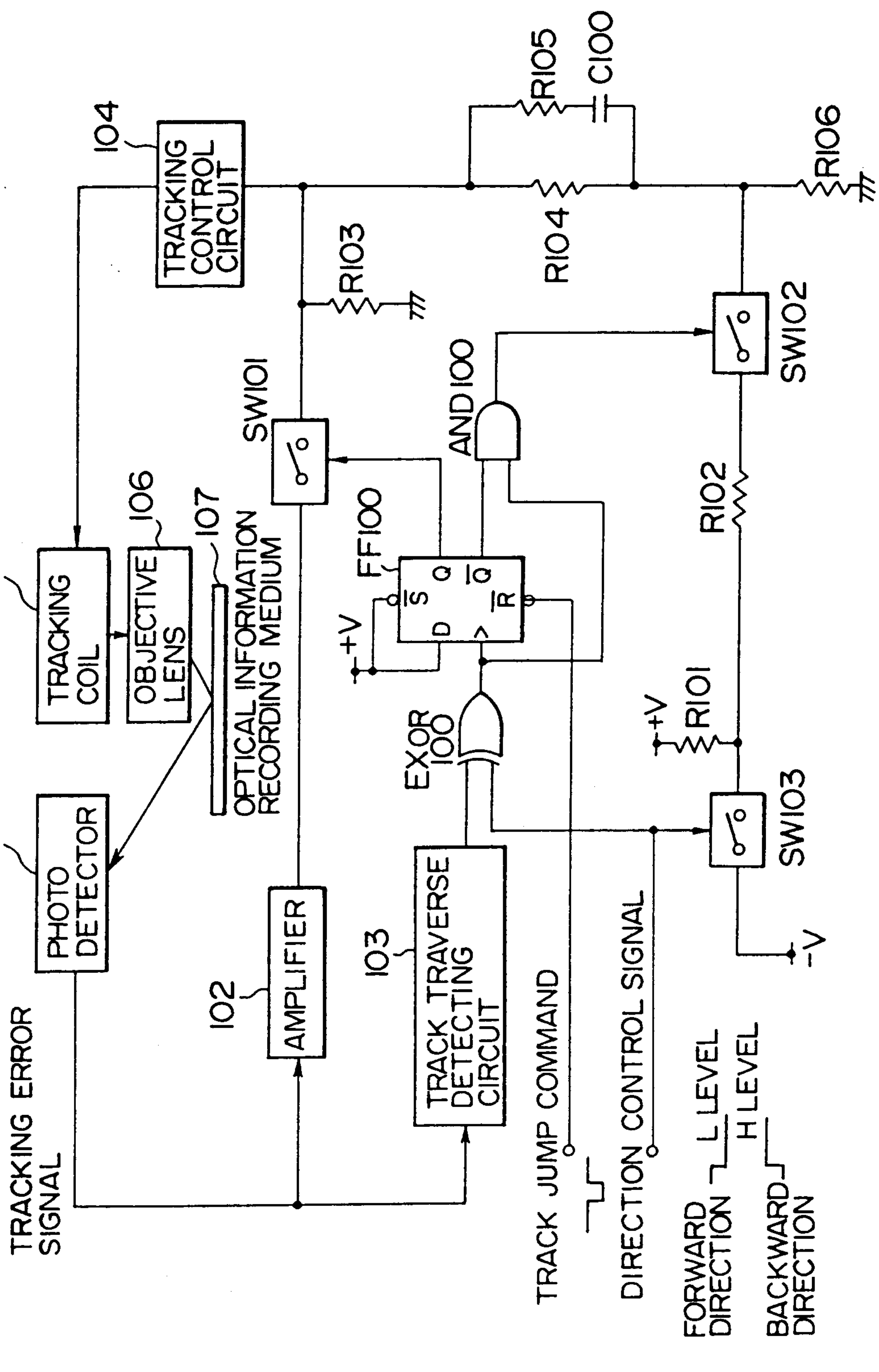
101
PHOTO DETECTOR
102
AMPLIFIER
103
TRACK TRAVERSE DETECTING CIRCUIT
104
TRACKING CONTROL CIRCUIT
105
TRACKING COIL
106
OBJECTIVE LENS
107
OPTICAL INFORMATION RECORDING MEDIUM
TRACKING ERROR SIGNAL
SW101
SW102
SW103
R101
R102
R103
R104
R105
R106
C100
AND100
FF100
D
S
Q
R
EXOR 100
+V
-V
TRACK JUMP COMMAND
DIRECTION CONTROL SIGNAL
FORWARD DIRECTION
L LEVEL
BACKWARD DIRECTION
H LEVEL

FIG. 1

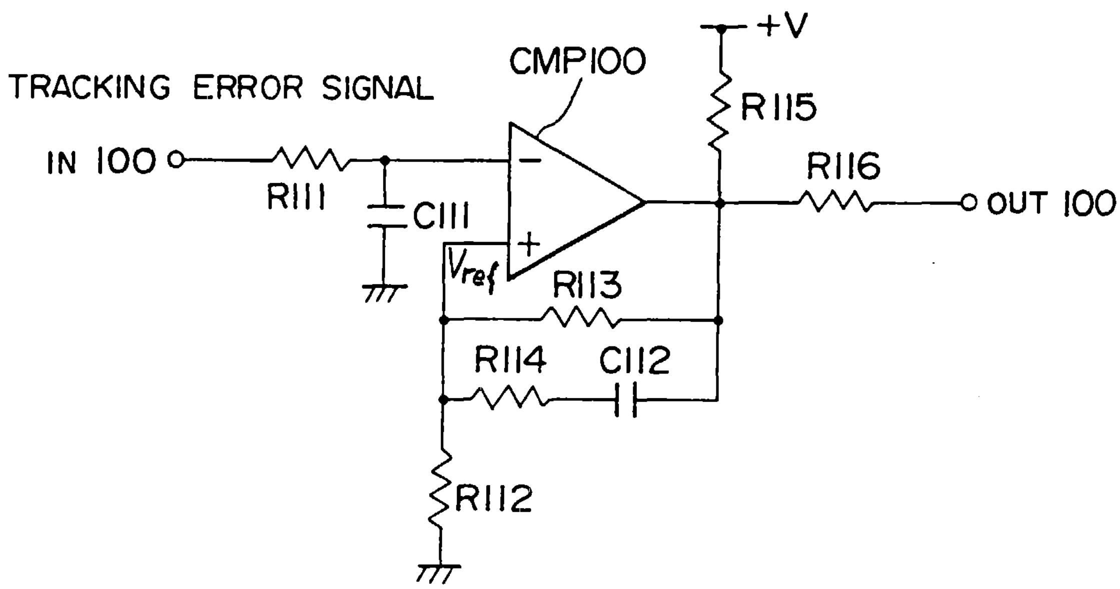
TRACKING ERROR SIGNAL
IN 100
R111
C111
CMP100
Vref
+V
R115
R116
OUT 100
R113
R114
C112
R112

FIG. 2

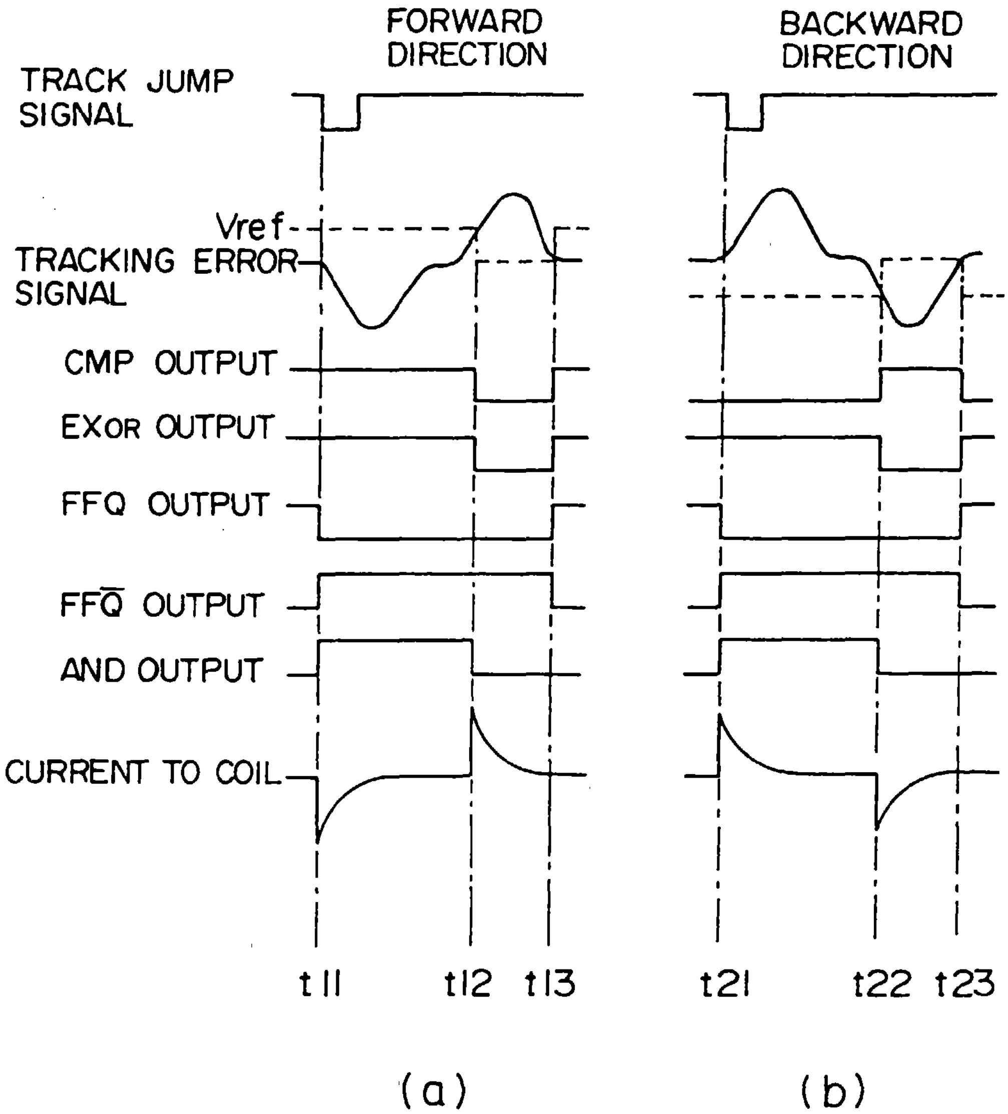
FORWARD DIRECTION
BACKWARD DIRECTION
TRACK JUMP SIGNAL
Vref
TRACKING ERROR SIGNAL
CMP OUTPUT
EXOR OUTPUT
FFQ OUTPUT
FFQ̄ OUTPUT
AND OUTPUT
CURRENT TO COIL
t11
t12
t13
t21
t22
t23
(a)
(b)

FIG.3